Nonlinear Damping of Fast Waves and Plasma Heating in the Solar Corona

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Fast waves can be excited in the corona by compressional perturbations of magnetic field lines which are anchored into the dense convective zone and displaced by the plasma motions there. The consequent linear dissipation of fast waves in the resonant layers can contribute to coronal heating. A difficulty of this dissipation mechanism is that the setup time of the linear resonance (the time required for the creation of sufficiently short length-scales) is long compared to the sub-minute variations in the coronal heating process. This suggests a more effective mechanism for the structurization of waves in the solar corona. We propose a new, nonlinear mechanism for the dissipation of fast waves in the corona. In the framework of two-fluid MHD we show that fast waves are nonlinearly coupled to the kinetic Alfvén waves - Alfvén waves with short wavelengths across B_0, background magnetic field. The nonlinear coupling is effective for the amplitudes of the launched fast waves in the range 0.01 to 0.03 for B/B_0 (B is wave magnetic field), implied by spectroscopic observations. As the excited AWs have very short wavelengths, they are damped almost immediately by the linear kinetic or collisional dissipation. Therefore, the resulting plasma heating has the overall timescale of the order of the characteristic time of nonlinear interaction, which can easily be in the sub-minute range.

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